

# AdvanTex<sup>®</sup> Design Criteria

## For Single-Family Home Applications — AX20 Treatment Unit

### System Description and Treatment Process

The AdvanTex<sup>®</sup> Treatment System is a multiple-pass, packed-bed aerobic wastewater treatment system specifically designed and engineered for long-term processing of residential strength wastewater. The treatment media is an engineered textile, which has an extremely high void capacity, moisture-holding capacity, and surface area per unit volume. Consequently, AdvanTex Treatment Systems are capable of processing residential strength wastewater to better than “secondary standards” (see Figure 3, page 3).

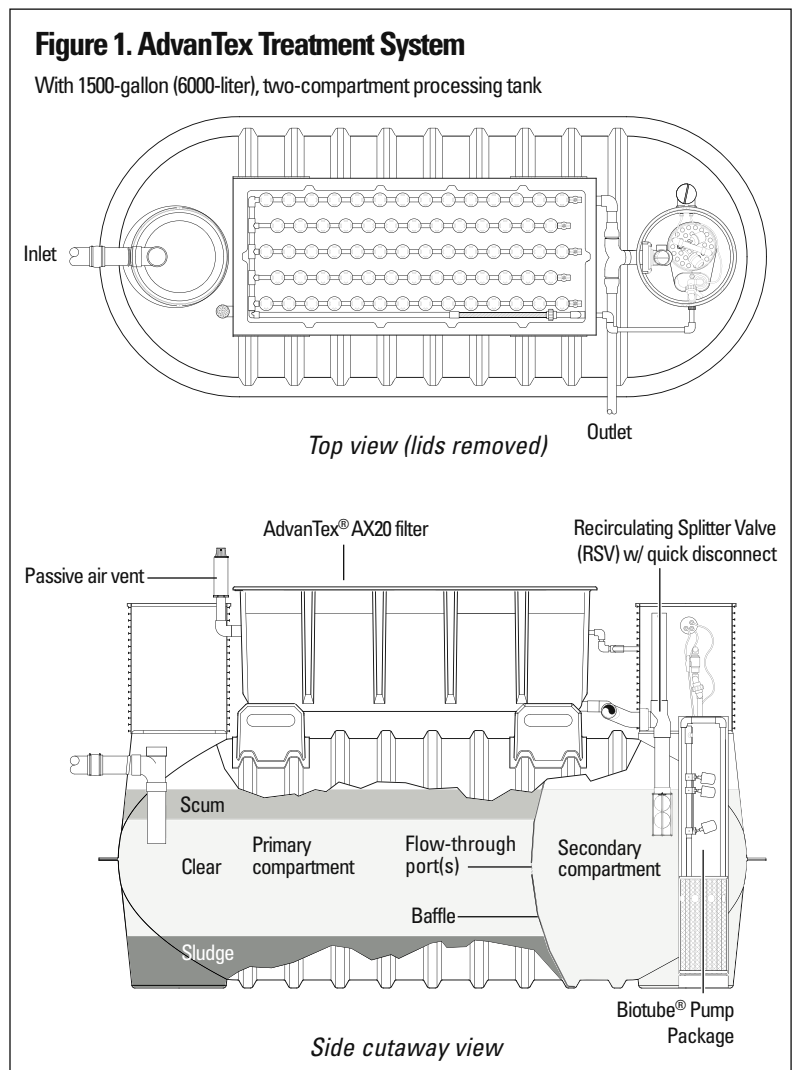
Here’s how it works in our standard configuration.

(See Figure 1.) Raw sewage enters the two-compartment Processing Tank through its inlet tee. In the first compartment, the raw sewage separates into three distinct zones: a scum layer, a clear layer, and a sludge layer. A flow-through port(s) in the tank’s baffle wall allows effluent from the clear layer to flow into the second compartment of the tank. The Biotube<sup>®</sup> Pump Package in the second compartment pumps filtered effluent to a distribution manifold in the AdvanTex filter. Effluent percolates down through the textile media and is collected in the bottom of the filter pod. The treated effluent flows out of the filter pod through the filtrate return line, which returns the treated effluent to the recirculating splitter valve (RSV). The RSV automatically splits or diverts the flow between the processing tank and the final discharge. The RSV also controls the liquid level within the processing tank. During extended periods of no flow, 100 percent of the treated filtrate effluent is returned to the processing tank. The residential AdvanTex filters have a passive vent system and do not require the use of a fan.

### System Selection: Models and Configurations

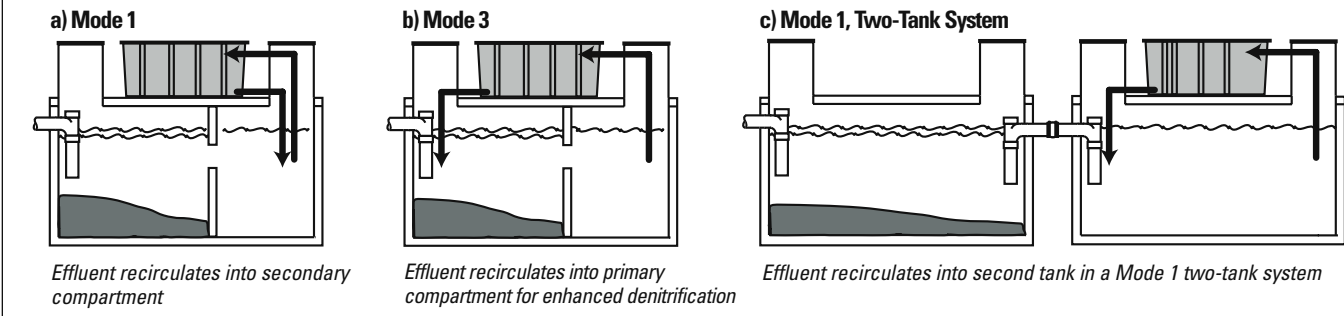
Residential-sized AdvanTex Treatment Systems include the AX20 and the AX20N. These models are identical; however, the AX20N’s label carries the NSF mark, per NSF protocol, and is sold in jurisdictions that require NSF-certified product tracking. The AdvanTex Treatment System can be configured in several modes. Mode 1 (shown in Fig. 2a) is the operating configuration used most frequently. In Mode 1, the filtrate recirculates through the second compartment of the processing tank. In Mode 3 (a specialty mode, shown in Fig. 2b), a portion or all of the filtrate may be recirculated through the primary chamber of the tank to enhance nutrient removal.

Some of the systems in Mode 1 incorporate two tanks: a primary tank and a recirculation tank. In the primary tank, sludge and scum are separated from liquid effluent, which then flows into a separate recirculation tank, into which the AdvanTex filtrate is recirculated (shown in Fig. 2c). Refer to the AdvanTex Treatment System drawings in the AdvanTex *Design/Engineering Package for Residential Applications* for further details on mode and discharge options.



# AX20 Residential Design Criteria (cont.)

**Figure 2. AdvanTex Treatment System Configurations**



## System Requirements: Residential Strength Wastewater

Residential wastewater must meet the criteria in Table 1, below. Consult Orenco or your AdvanTex Dealer for larger system designs.

**Table 1. Residential Strength Wastewater (Influent Characteristics)<sup>1</sup>**

Characteristic	Average (mg/L)	Weekly Peak (mg/L)	Rarely Exceed (mg/L)
CBOD <sub>5</sub>	130	200	300
TSS	40	60	150
TKN	65	75	150
G&O	20	25	25

<sup>1</sup> AdvanTex® Treatment Systems are typically expected to receive residential-strength wastewater from primary septic tanks. Residential-strength wastewater is defined as primary sewage effluent from a septic tank that does not exceed the parameters in this table.

## System Requirements: Processing Tank

Homes with up to four bedrooms require a minimum two-compartment, 1,500-gal (5,700-L) tank with flow-through port(s) equaling a minimum flow-through area of not less than 12 in<sup>2</sup> (77 cm<sup>2</sup>) at 60 to 70 percent of the lowest normal liquid level. In larger residential systems, the first compartment should be sized at approximately 66 to 75 percent of the total processing tank volume. Table 2 defines the minimum required tankage for residential AdvanTex applications (unless otherwise approved by both Orenco and the local regulatory body).

All tanks must meet Orenco's minimum structural requirements, be completely watertight, and pass a watertight test including the riser/tank connection. For detailed specifications, see structural and watertightness criteria in Orenco's *General Specifications*, NSP-EFS-SPEC-1 and *Acknowledgment of Minimum Tank Requirements*, SLD-TNK-SPEC-1, as well as the tank specifications checklist in Orenco's *Concrete Tank Questionnaire*, NCL-TNK-TNK-1.

## System Selection: Required Tankage and Filter Units

The following tables summarize the required tankage and required number of textile filter units based on occupancy and maximum design flow. Table 2 is for systems using a single processing tank. Table 3 is for systems using separate septic and recirculation tanks.

Requirements assume that residential peak weekly average flows ( $Q_{pwa}$ ) are typically two times normal average daily flows ( $Q_a$ ) (in other words,  $Q_{pwa} = 2Q_a$ ), and peak weekly average flows meet typical regulations governing gpd-to-bedroom ratios.

**Table 2. Required Tankage and Number of Filter Units: Systems Using Single Processing Tank**

Number of Bedrooms <sup>1</sup>	Occupants <sup>2</sup> maximum	Processing Tank minimum size, gal. (L)	AX Units <sup>4</sup> model
4 (or fewer)	8	1,500 (5,700)	1 – AX20 <sup>5</sup>
5	10	2,500 (9,500)	2 – AX20 <sup>5</sup>
6	12	3,000 (11,400)	2 – AX20 <sup>5</sup>

<sup>1</sup> Use bedrooms as default sizing criteria. (States vary greatly on calculations of gallons per bedroom.) For homes with more than six bedrooms or larger than 5,000 ft<sup>2</sup> (465 m<sup>2</sup>), consult Orenco Systems, Inc.

<sup>2</sup> Systems with occupancies greater than eight require a design with multiple units based on a minimum of 2.5 ft<sup>2</sup> (0.2 m<sup>2</sup>) of surface loading area per capita.

<sup>3</sup> Processing tank includes primary (septic) and secondary (recirculation) compartments.

<sup>4</sup> The hydraulic application rate for all residential AX units is 29.1 gpd/ft<sup>2</sup> (1184 L/m<sup>2</sup>/day); the nominal hydraulic application rate is 25 gpd/ft<sup>2</sup> (1019 L/m<sup>2</sup>/day).

<sup>5</sup> For jurisdictions that require NSF-certified product tracking, the AX20N model should be specified.

# AX20 Residential Design Criteria (cont.)

**Table 3. Recommended Tankage and Number of Filter Units: Systems Using Separate Septic/Recirc Tanks\***

Number of Bedrooms <sup>1</sup>	Occupants <sup>2</sup> <i>maximum</i>	Septic Tank <i>minimum size, gal. (L)</i>	Recirc Tank <sup>3</sup> <i>minimum size, gal. (L)</i>	AX Units <sup>4</sup> <i>model</i>
4 (or fewer)	8	1,000 (3,800)	1,000 (3,800 L)	1 – AX20 <sup>5</sup>
5	10	1,500 (5,700)	1,000 (3,800 L)	2 – AX20 <sup>5</sup>
6	12	2,000 (7,600)	1,000 (3,800 L)	2 – AX20 <sup>5</sup>

\* See Fig. 2c on previous page.

<sup>1</sup> Use bedrooms as default sizing criteria. (States vary greatly on calculations of gal/bedroom.) For homes greater than six bedrooms or greater than 5,000 ft<sup>2</sup> (465 m<sup>2</sup>), consult Orenco Systems, Inc.

<sup>2</sup> Systems with occupancies greater than eight require a design with multiple units based on a minimum of 2.5 ft<sup>2</sup> (0.2 m<sup>2</sup>) of surface loading area per capita.

<sup>3</sup> The 1,000-gal minimum is due to float settings/reserve requirements.

<sup>4</sup> The hydraulic application rate for all residential AX units is 29.1 gpd/ft<sup>2</sup> (1184 L/m<sup>2</sup>/day); the nominal hydraulic application rate is 25 gpd/ft<sup>2</sup> (1019 L/m<sup>2</sup>/day).

<sup>5</sup> For jurisdictions that require NSF-certified product tracking, the AX20N model should be specified.

## Design Loading Rates

Orenco's suggested design loading rates are based on typical per capita flow rates (50 to 60 gal/day/person or 189 to 227 L/day/person) and average strength characteristics expected from residential type installations, as shown in Table 1. Performance is a function of the expected typical loads with periodic weekly highs. Typically, the daily mass loading is based on the expected daily flows and actual strength. Figure 3 shows periodic peak loading capacity at a 95% confidence level. If the loading rate (or mass load) needs to be reduced to meet discharge limits, it's a simple matter of adding additional modular units.

Orenco Systems, Inc.'s AX20N AdvanTex Treatment System is listed as an NSF/ANSI Standard 40 Class I treatment unit, and the listing is for flows up to 1,500 gpd (5,700 L/d) in various configurations.

## Typical Effluent Quality

Effluent quality is dependent on a number of factors, including influent characteristics and loading rates. Figure 3 shows third party, NSF/ANSI Standard 40 testing results. The results demonstrate that low-to-moderate loading rates typically produce CBOD<sub>5</sub> and TSS of <5 mg/L, while higher loading rates produce CBOD<sub>5</sub> and TSS in the range of 15-25 mg/L. Field testing of systems in real-world conditions shows similar results, with CBOD<sub>5</sub> and TSS of <10 mg/L. (See *AX Performance Summary*, AHO-ATX-PERF-1.)

Nitrogen reduction in Mode 1 will typically exceed 60 percent, with total nitrogen in the filtrate ranging between approximately 25 and 35 mg/L. In Mode 3, nitrogen reduction can reach 70 percent or better, depending on wastewater strength and other characteristics like grease and oils, pH, and alkalinity concentrations. Nitrification can be inhibited if the buffering capacity (alkalinity) of the wastewater is too low. On a theoretical basis, 7.14 mg/L of alkalinity as CaCO<sub>3</sub> is needed to nitrify 1 mg/L of NH<sub>4</sub><sup>+</sup>.

## Pumping Equipment: Recirculation Pump

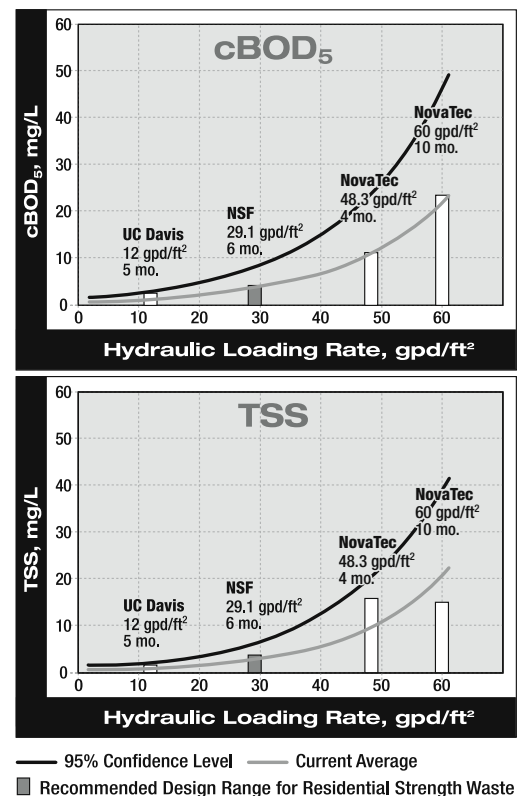
The integrated treatment package includes an Orenco 4-inch (100-mm) submersible effluent pump, a Biotube<sup>®</sup> pump vault, a float assembly with floats, a hose and valve assembly, a splice box, and a control panel.

## Residual Head Pressures

A residual pressure of 5 ft (1.5 m) is used to determine the initial timed-dosing settings. (Residual pressure may vary depending on system hydraulics and/or special treatment requirements.) Consulting with Orenco is required when the residual pressure dosing falls outside the typical range of 3 to 6 feet (0.9 to 1.8 meters).

**Figure 3.**

### Effluent Quality vs. Hydraulic Loading Rates ANSI/NSF Standard 40 and Other Third Party Testing Results



# AX20 Residential Design Criteria (cont)

## Recirculation Ratios and Timer Settings

The AdvanTex Treatment System's initial timer settings should be established based on the expected average daily flow and a 4:1 recirculation ratio (filter recirculation ratio). If flows vary significantly from expected flows, timer settings can easily be recalculated and adjusted. See "AX20 Timer Settings Worksheet" in the *Residential AX Installation Manual*, NIM-ATX-AX-1, for more information.

## AdvanTex Control Systems

Critical to the success of the AdvanTex Treatment System is the method in which the effluent is loaded onto the AdvanTex textile filter. Over the past three decades, timer-controlled applications have proven to play an essential role in optimizing the performance of both fixed and suspended growth biological systems. A timer-controlled pump in the processing tank periodically doses effluent to a distribution system on top of the AdvanTex filter. Each time the filter is dosed, effluent percolates through the filter media and is treated by naturally occurring microorganisms that populate the filter. During periods of high flow, a timer override float will temporarily modify the timer settings to process the additional flow. Conversely, during periods of low flow, the timer settings can be modified to reduce loading onto the AdvanTex filter. Orenco offers two timed-dose control panels with the AdvanTex Treatment System.

Orenco's VeriComm® (VCOM) remote telemetry control panels and Web-based monitoring system are incorporated into all AdvanTex Treatment System standard equipment packages. VeriComm gives wastewater system operators and maintenance organizations the ability to monitor and control each individual system's performance remotely. There are several additional operational benefits associated with telemetry-based controls, including Advanced Control Logic — functions that activate in the event of component malfunction to diagnose the system using pre-established trend data and, if necessary, modify the operation of the system until it can be serviced. VeriComm also provides additional alert and alarm functions to notify the operator/designer in the event that trend data indicate potential problem conditions (e.g., high flows).

In some markets, Orenco offers our Most Versatile Panel (MVP) series panels as an alternative to our VCOM panels. MVP control panels include an easy-to-use programmable logic unit that incorporates many timing and logic functions. The units have built-in screens that show time and date, elapsed pump run times, pump cycle counts, high-level alarm and override cycle counts, and low-level alarm counts, as well as power fault information and operating hours. In addition, there are separate screens that show the status of the panel's digital inputs and outputs. These features give operators and maintenance providers the ability to monitor individual systems on site. Alarm events activate the panel's audible and visual alarms.

## Surge Volume

For most residential applications, the recommended surge volume is approximately 150 to 250 gallons (570 to 950 L). The actual surge volume used should be approximately 50 to 100 percent of the actual average daily flow. The surge volume is the volume between the normal low liquid level and the override timer float. The normal low liquid level is the level at which 100 percent of the filtrate returns to the tank. For most residential installations, the low liquid level will be approximately 5 to 6 inches (130 to 150 mm) to below the top of the RSV cage. Refer to the *AdvanTex Installation Guide*, NIM-ATX-AX-1, for details.

## Reserve Volume

A typical AdvanTex Treatment System on a four-bedroom home has a 1,500-gallon processing tank. There are about 400 gallons (1,500 L) of emergency storage between the normal operating liquid level and the inside top of the tank. Assuming that the average home produces about 250 gpd (950 L/d), the emergency storage volume in an AdvanTex system is sufficient for 1.5 days.

Power outage: During a power outage, water usage will be significantly reduced because water heaters, dishwashers, and laundry equipment will not be used. Under these conditions, it is realistic to estimate that water usage will be reduced by 50 percent to around 125 gpd (475 L/d). Therefore, in a power outage, the emergency storage capacity available in an AdvanTex system increases to approximately three days' worth. Because power outages typically last no more than one day, the emergency storage of an AdvanTex system is adequate.

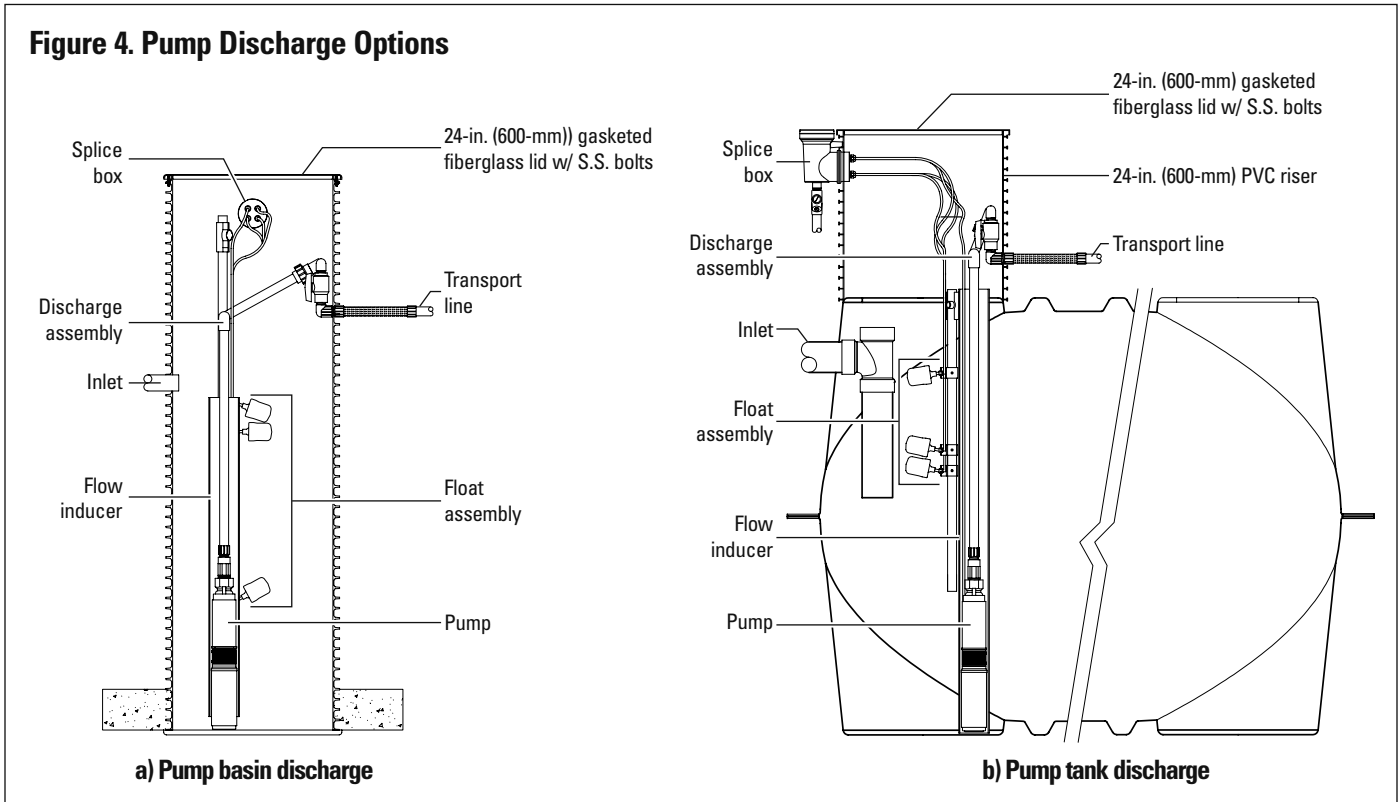
Mechanical component failure: Failure of a pump or electrical component may cause the system to stop operating, requiring some amount of emergency storage volume. The VeriComm Monitoring System immediately notifies the Authorized Service Provider of the alarm condition and indicates the cause of the alarm. This allows the Service Provider to bring the right replacement component. In most cases, no more than one day (250 gallons or 950 L) would be needed for the Service Provider to respond and get the system running again.

## Discharge Equipment

There are two discharge options: gravity and pump. When discharging by pump, an Orenco pump basin can be used. (See Figure 4a.) Alternatively, some designs may call for pumping out of a tank. (See Figure 4b.)

All tanks must meet Orenco's minimum structural requirements, be completely watertight, and pass a watertight test including the riser/tank connection. For detailed specifications, see structural and watertightness criteria in Orenco's *General Specifications*, NDA-DG-SPEC-1 and *Acknowledgment of Minimum Tank Requirements*, SLD-TNK-1, as well as the tank specifications checklist in Orenco's *Concrete Tank Questionnaire*, NCL-TNK-TNK-1.

**Figure 4. Pump Discharge Options**



## Cold Weather Considerations

AX20 units are available with 1-in. (25-mm) insulation attached to the bottom of the lid. Installing insulation around the sides of the filter pods themselves is optional and is done on site as needed. Other cold weather considerations include standard practices used with most onsite pump systems, such as allowing all lines to drain, insulating processing tank lids, and backfilling risers with pea gravel if frost-heave is a concern. The filter vent may need to be extended above the highest level of the snowpack during winter months. Consult Orenco if supplementary options need to be considered.